25X1 [redacted]

9 September 1966

R E G I S T E R E D

25X1 [redacted]

Post Office Box 8031
Southwest Station
Washington, D. C. 20024

25X1 Subject: [redacted] Project 552A Cabinets, Electronics and Encoder Installation on Model 552A Machines, [redacted] 25X1

25X1 [redacted]

Gentlemen:

In accordance with the meeting held at your facility on 19 August 1966, in which you requested quotations with respect to digitizing the delivered 552A machines and/or adding interferometric measuring capabilities to the 552A machines, our initial studies indicate that, from a practical view-point and from a review of the economics of the modifications, our proposed approach is to add digitizing capabilities to the existing equipment on a minimum cost basis and to then supply as a separate item, a calibration system which involves fixturing and a 2-axes laser interferometer for the calibration of all your 552 machines. The calibration system will be so designed with the proper fixtures that it will be mountable on both the 552 machine and the 552A machines. The proposal for the calibration system is presently in preparation and will be submitted to you within two (2) weeks.

Below is described the modifications we are proposing to make to the two (2) 552A machines at your facility with the appropriate cost quotation.

1) Purchase and modify 50 inch high Emcor cabinet on casters to house four (4) [redacted] counter/display units, one (1) [redacted] synchronizer and one (1) [redacted] switch panel. Two (2) filler panels will be provided: one to space left and right X-Y counter/display units and the other to enclose unused rack area. A hinged rear door will be installed to

25X1 25X1 25X1

[redacted]

[redacted]

permit convenient access to equipment cables and will contain two (2) fans for improved cooling of electronics.

2) Design, fabricate and install special sloped front cabinet for [redacted] control panel similar to 552 installation. 25X1

3) Design, fabricate and install arm for sloped front cabinet on side of Emcor cabinet, arm and sloped front cabinet will be designed so these will be about 15 degree aximuth adjustment available to suit operator's comfort, similar to 552 installation.

4) Design, fabricate, purchase and install panel to contain necessary connectors and [redacted] 25X1
25X1 [redacted] 15-EL-44 modules to mate counter/display units to
25X1 encoders and [redacted] switch panel.

5) Fabricate and install cables needed to interconnect encoder and elements of the readout system.

6) Purchase and install four (4) [redacted] Model 2826C 25X1
25X1 Reversible Counters, (1) [redacted] Model 2827B Synchronizer, one (1)
25X1 [redacted] Model 2825B Control Panel, four (4) [redacted] Model 25X1
25X1 27-625Z [redacted] Encoders, and four (4) [redacted] Model
15-EL-44 Electronic Modules.

The cost estimates for the above described tasks are attached hereto. It should be pointed out that both estimates are based on accomplishing the modifications to the machines at your facility rather than returning the machines for modifications at our plant. The cost estimate sheets are submitted for accomplishing one (1) machine and accomplishing two machines at the same time. If two machines are modified but with a time difference at installation the cost of a single machine would have to be used for each of the equipments.

This proposal is submitted on the basis of a firm fixed price contract with progress payments in the amount of 75%. Upon completion of the modification and installation acceptance, full payment within 30 days is desired. This proposal is valid for 60 days from the date of this letter. It is expected that the contract will take five (5) months to complete after authority to proceed.

25X1

[redacted]

25X1

[redacted]

9 September 1966

If you desire any additional information, or any questions answered of a technical nature, please contact [redacted] 25X1 all other matters should be referred to the undersigned.

Very truly yours,

[redacted] 25X1

Executive Vice President

LHB:rf
Encl: (2) Cost Sheets 1 & 2

25X1 cc: [redacted] w/enclosure

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THE FOLLOWING EXAMPLE USES DATA FROM 552 POINT TRANSFER DEVICE CALIBRATION TESTS FOR RIGHT X CHANNEL MEASUREMENT ERRORS TAKEN SEPT. 14-15, 1966

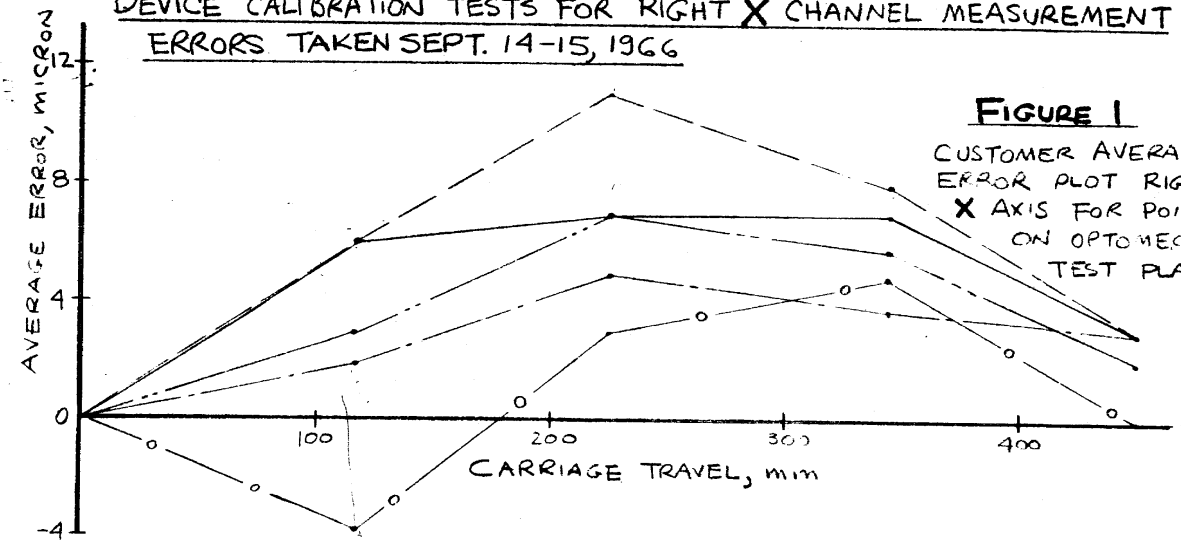


FIGURE 1

CUSTOMER AVERAGE ERROR PLOT RIGHT X AXIS FOR POINTS ON OPTOMECHANICAL TEST PLATE.

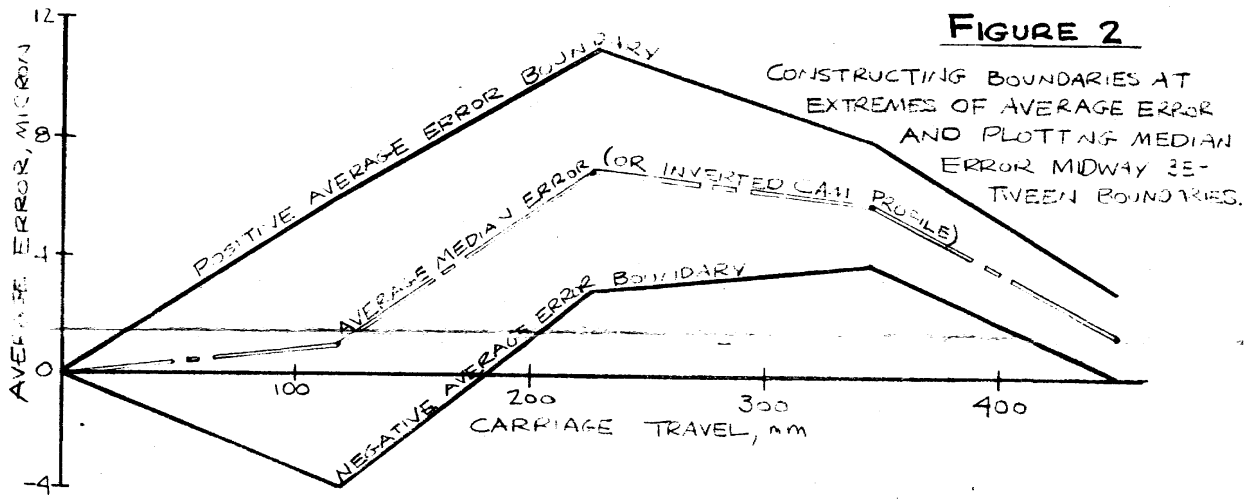
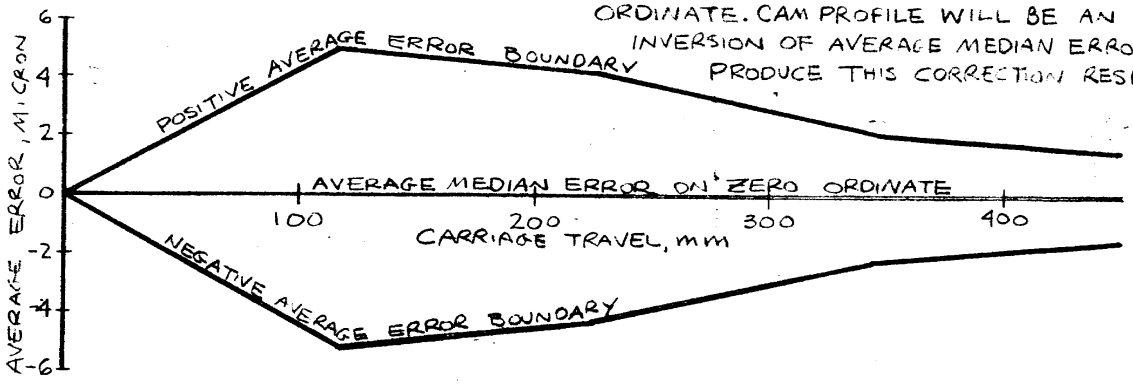


FIGURE 2

CONSTRUCTING BOUNDARIES AT EXTREMES OF AVERAGE ERROR AND PLOTTING MEDIAN ERROR MIDWAY BETWEEN BOUNDARIES.

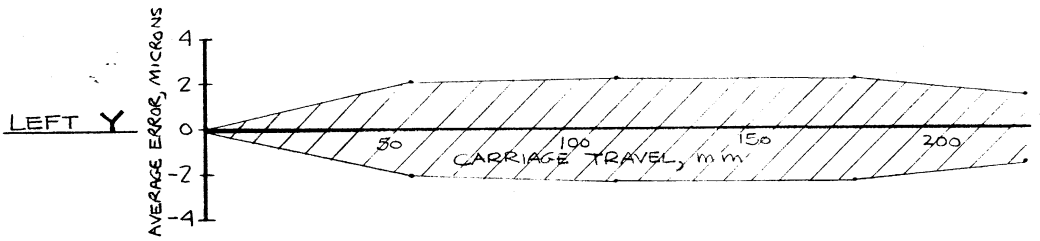
FIGURE 3

ADJUSTING AVERAGE MEDIAN ERROR TO BE SUPERIMPOSED ON ZERO AVERAGE ERROR ORDINATE. CAM PROFILE WILL BE AN INVERSION OF AVERAGE MEDIAN ERROR TO PRODUCE THIS CORRECTION RESPONSE.



PRINCIPLE OF MEASUREMENT ERROR CORRECTION USING CAM ADJUSTED ENCODER MOUNT

WB 1/25/67



NOTE

① BASED ON DATA TAKEN SEPT. 14-15, 1966 USING [ ] TEST PLATE.

② AVERAGE OF MEASUREMENT ERRORS OF CHECK POINTS ON TEST PLATE LIE WITHIN BOUNDARIES OF CROSSHATCHED AREAS.

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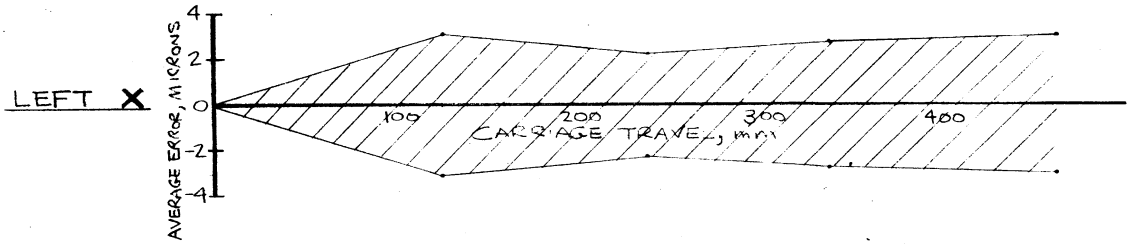
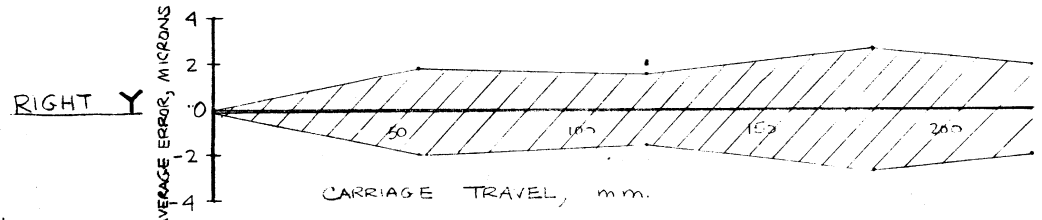


AVERAGE MEASUREMENT ERROR WITH CAM ADJUSTED ENCODER MOUNT ON LEFT X & Y AXES 552 POINT TRANSFER DEVICE

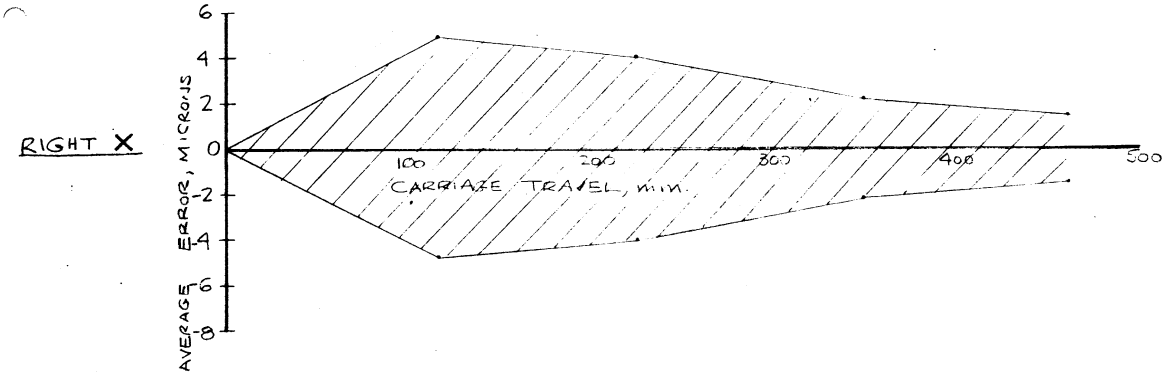
NB 1/20/67



25X1 NOTE

① BASED ON DATA TAKEN SEPT. 14-15, 1966 USING [redacted] TEST PLATE

② AVERAGE OF MEASUREMENT ERRORS OF CHECK POINTS ON TEST PLATE LIE WITHIN BOUNDARIES OF CROSSHATCHED AREAS.



AVERAGE MEASUREMENT ERROR WITH CAM ADJUSTED ENCODER MOUNT ON RIGHT X & Y AXES

552 POINT TRANSFER DEVICE

WB 1/24/67

[redacted]

10/67-A 25X

[redacted]

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 [redacted]

31 March 1967

REGISTERED

Reference: Our Letter Dated 18 January 1967 - "Quotation for Modification of 552 Type Equipments to Include Film Drive and Encoder Installation" - and Associated References

Subject: Quotation for Modification of 552/552A Type Equipments to Include Cam Adjustment, Encoder, and Film Drive Assist

Gentlemen:

As a result of the submission of referenced letter and a recent visit by Mr. JR for further discussions with respect to referenced letter, [redacted] is pleased to submit herewith our quotations for the following:

1. Installation of Cam Adjustment Correction System to the 552A-101 and (if desired) the 552-101

2. Installation of Encoders and Counters, including Cabinetry, on 552A-101

3. Installation of Film Drive Assist on the 552A-101 and/or 552-101

The pricing information submitted on previous quotations of the above [illegible] hereby made null and void, and the quotations included herewith shall be considered valid for sixty (60) days from the date of this letter. The technical descriptions previously submitted with respect to the above shall remain valid and are herewith further supplemented to amplify our technical approach to assure that there will be no misunderstanding in the future.

X1 [redacted]

Exhibit "A", attached hereto, further amplifies and explains the Cam Adjustment feature proposed herein. Exhibit "B", attached, comprises suggested Work Statement covering the Encoder Installation, including [redacted] stipulations with respect to the utilization of Customer Furnished Property. The Power Assist Film Drives proposed herein can be considered identical to the Film Drive System presently installed on Machine 552A-104, ready for delivery to your facility.

X1

This proposal is for installation of the equipment and systems described at your facility. The approach to be taken would be to accomplish as much of the preliminary work and fabrication at [redacted] and deliver the modification kits to your facility, and only at that time would the 552A-101 be pulled out of commission and modifications made. It is expected that the actual effort at your facilities would take approximately six (6) weeks. The Film Drive modification on the 552-101 equipment would be conducted subsequently to the above work on the 552A equipment and would take approximately three (3) weeks. The total contract duration would encompass a total of five (5) months for the 552A equipment and an additional month for the 552.

X1

Quotation sheets are included herewith covering the following:

25X

1. Cam Adjustment Modification

   This cost estimate is applicable to the 552A-101. If you also desire to have the same modification made on the 552-101, the cost analysis attached should be doubled.

2. Encoder Installation

3. Power Assist Drive for 552A-101

4. Power Assist Drive to be Installed on both 552A-101 and 552-101

[redacted]

The above quotations are made on the basis of a firm fixed price contract independent of any existing contracts with your facility. Request for progress payments in the amount of 75% is herein made. The

X1 [redacted] -3- 31 March 1967

quotations are also based upon payment within thirty (30) days after installation and acceptance. The acceptance period shall not exceed thirty (30) days.

If you desire any additional information with respect to the above, please do not hesitate to contact [redacted] or the undersigned. 25X

Very truly yours,

[redacted] 25X

Executive Vice President

LHB/aw
Encs. (2) Exhibit "A" and Drawings
(2) Exhibit "B"
Cost Estimate Sheets

X1 cc: [redacted]

EXHIBIT "A"

Cam Adjustment Modification

The following statements are to clarify previous descriptions and the expected performance of the cam adjustment mechanism:

1. The cam surface is to be made up of five (5) easily removable straight segments that may be reshaped to correct for future measurement system calibrations.

2. The cam adjustment modification will correct for lead screw errors and minimize errors due to way curvature. On example shown in the attachment, "Principle of Measurement Error Correction using Cam Adjusted Encoder Mount" depicts the right X carriage on the 552 #101 and shows that a +12 to -4 micron error spread for 450mm travel can be reduced to ± 6 micron.

The significance of the remaining errors (shown in Figure 3 of the attachment) are due to way curvature influencing X measurement errors at different Y planes for a nominal X position on the test plate. Another way to visualize this is to imagine these errors as the combined effect of azimuth motion of the "Y" axis upon the elevation motion of the "X" axis.

The ultimate corrective effect on measurement error by cam mechanism depends upon the present way distortion and alignments of system. The present status and accuracy of the machine is not known at this time, and ultimate accuracy after correction cam cannot be predicted.

EXHIBIT "A"

Continued . . .

3. The cam mechanism should have repeatability of better than 1 part in 50, as referred to a relative change in an angle between encoder body and the fixed part of its mount for a given carriage position. Since this is a small part of the correction effort of 25 parts in 2500, the uncertainty in the cam mechanism is small.

4. To check the correction function, at any time, the cam may be pulled away from its follower, the encoder held stationary, and a system calibration performed and compared with a run with the correction cam operating. If necessary, cam segments may be shifted and/or altered as future changes in system errors occur and need compensation.

THE FOLLOWING EXAMPLE USES DATA FROM 552 POINT TRANSFER DEVICE CALIBRATION TESTS FOR RIGHT X CHANNEL MEASUREMENT ERRORS TAKEN SEPT. 14-15, 1966

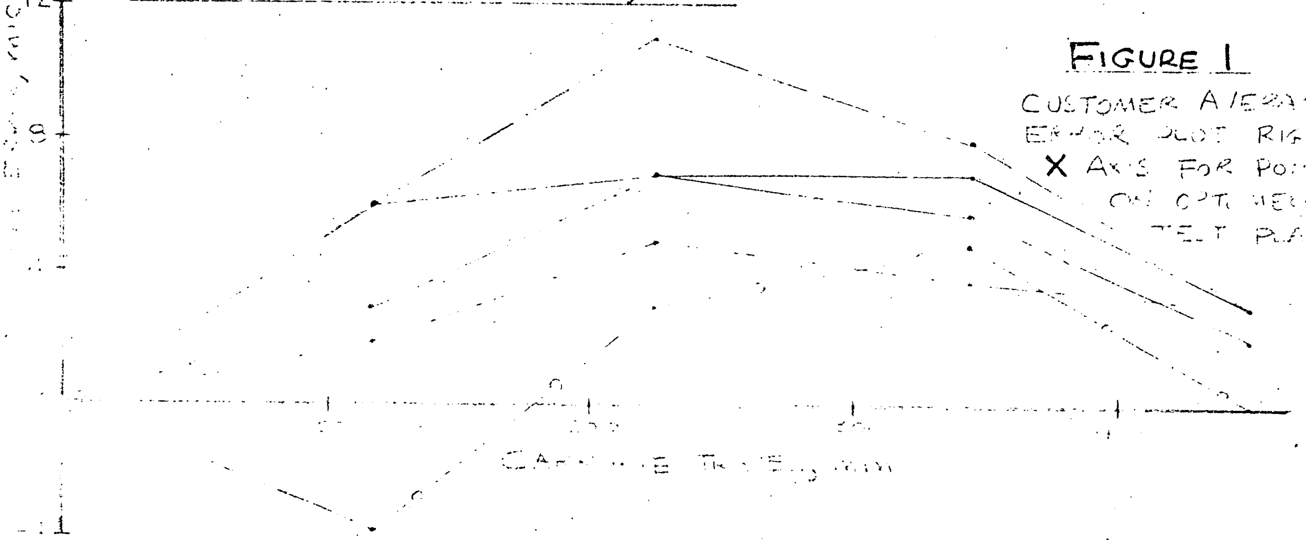


FIGURE 1

CUSTOMER AVERAGE ERROR PLOT RIGHT X AXIS FOR POINT ON OPT. MEDIAN TEST PLATE

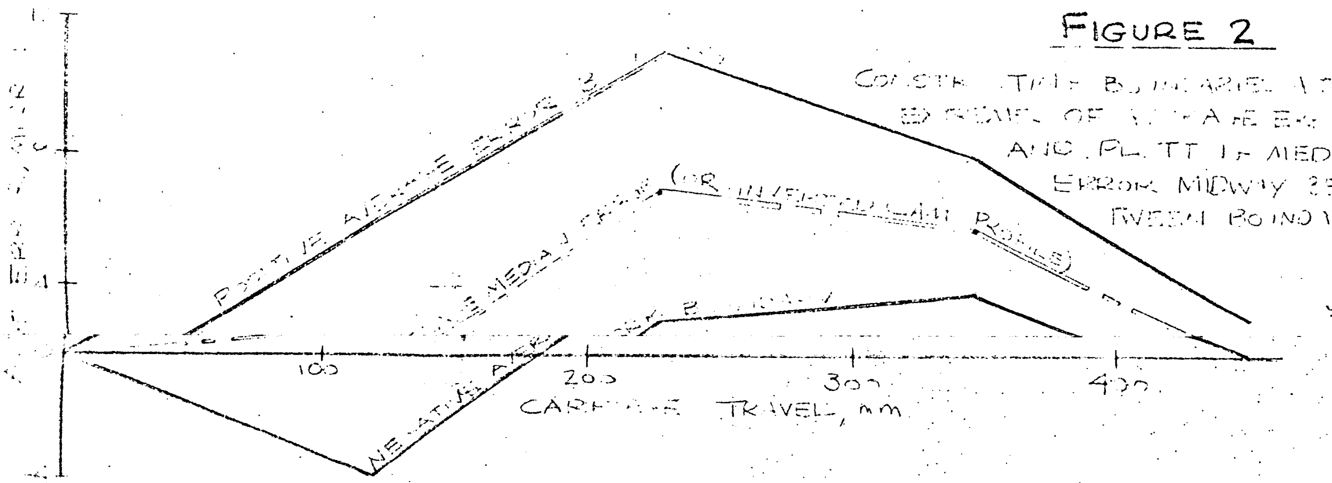


FIGURE 2

CONSTRUCTIVE BOUNDARIES AT EXTREMES OF AVERAGE ERR AND PLOTTING MEDIAN ERROR MIDWAY BETWEEN BOUNDARIES

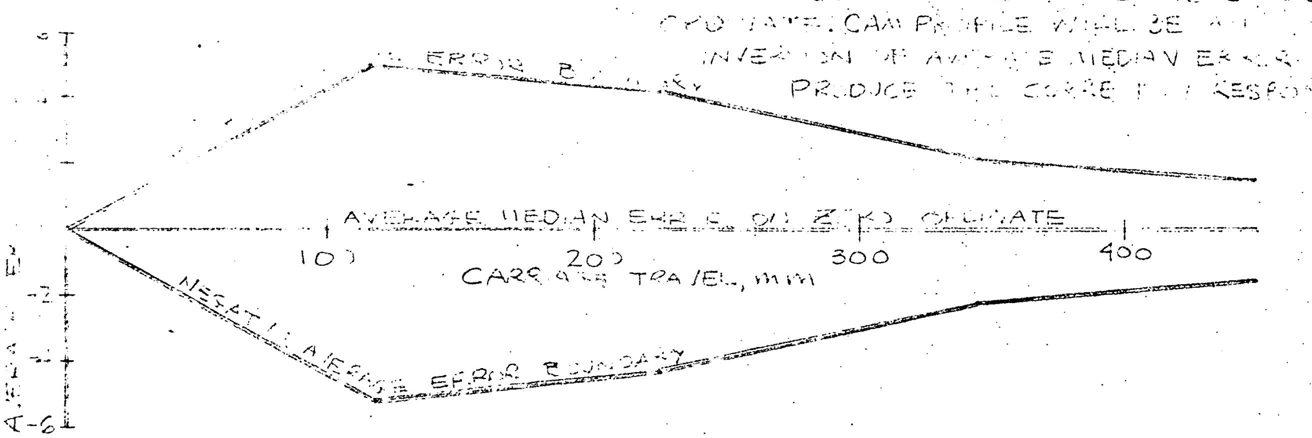
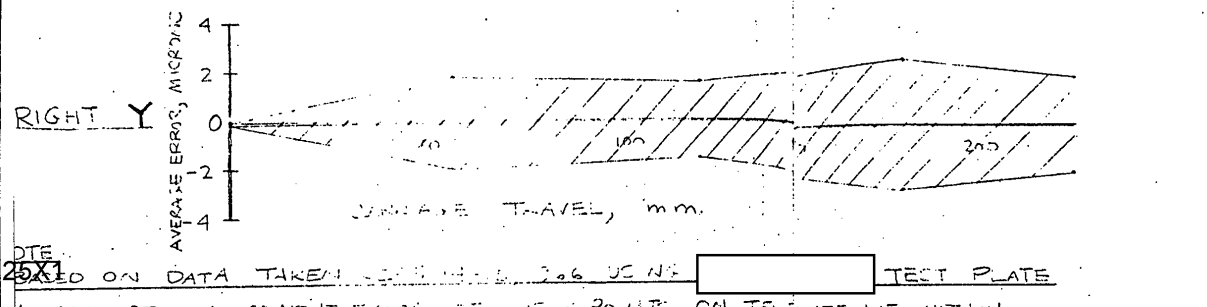


FIGURE 3

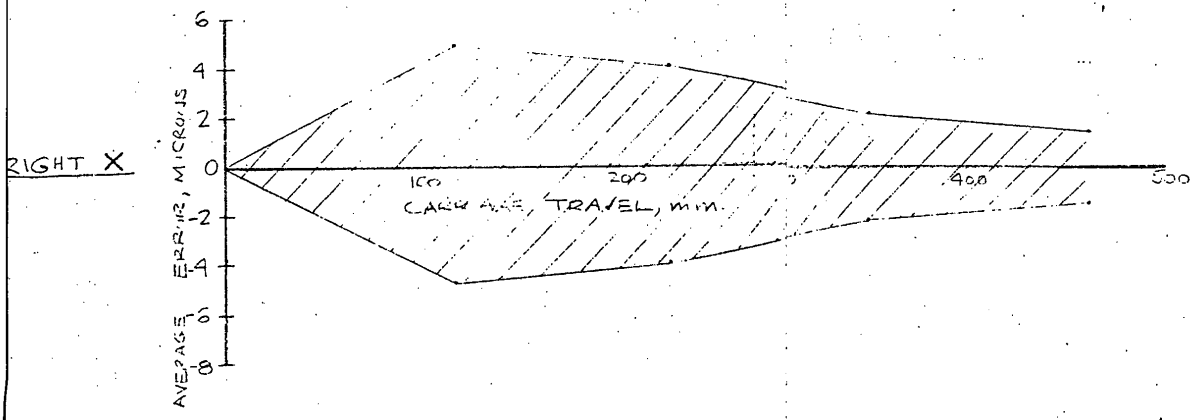
ADJUSTING AVERAGE MEDIAN ERROR TO BE SUPERIMPOSED ON ZERO AVERAGE ERROR ORDINATE. CAM PROFILE WILL BE AN INVERSION OF AVERAGE MEDIAN ERROR TO PRODUCE THE CORRESPONDING RESPONSE

PRINCIPLE OF MEASUREMENT ERROR CORRECTION USING CAM ADJUSTED ENCODER MOUNT

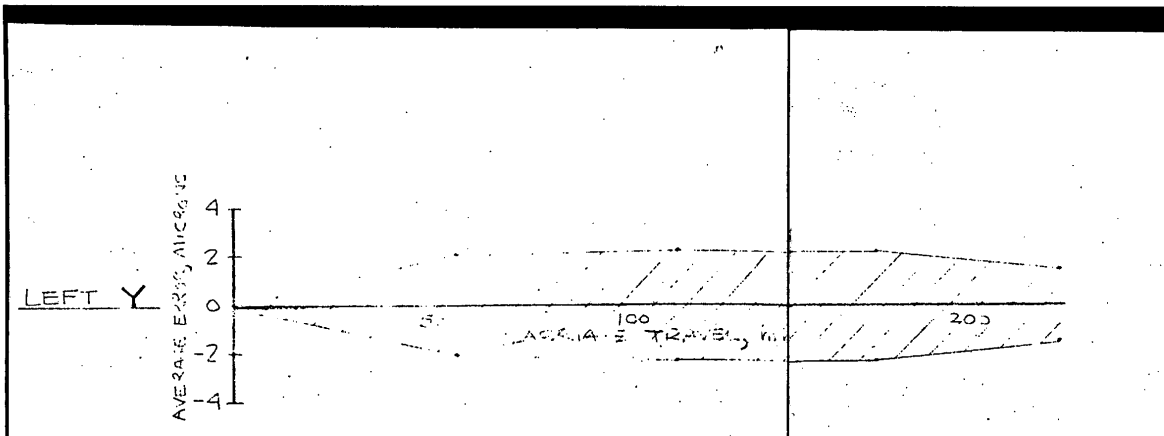


DTE
25X1
BASED ON DATA TAKEN [redacted] 206 UC NF [redacted] TEST PLATE

AVERAGE OF MEASUREMENT ERROR OF [redacted] POINTS ON TEST PLATE LIE WITHIN BOUNDARIES OF CROSSHATCHED AREAS.



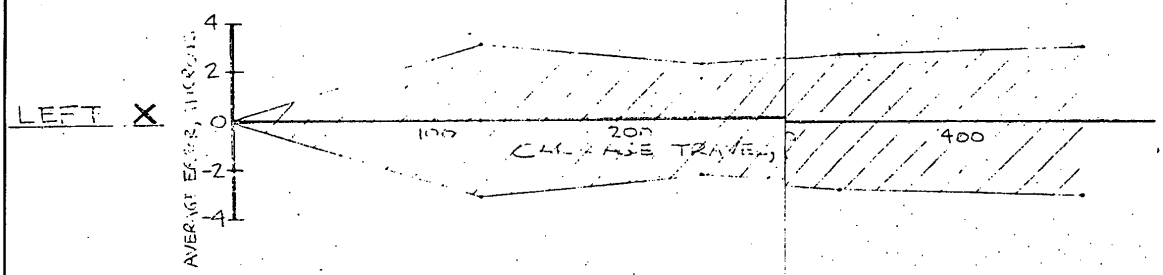
AVERAGE MEASUREMENT ERROR WITH CAM ADJUSTED ENCODER MOUNT IN RIGHT X & Y AXES



NOTE

1) BASED ON DATA TAKEN SEPT. [redacted], 1966 USING [redacted] TEST PLATE.

2) AVERAGE OF MEASUREMENT ERRORS OF CHECK POINTS OUT PLATE LIE WITHIN BOUNDARIES OF CROSSHATCHED AREA.



AVERAGE MEASUREMENT ERROR WITH CAM ADJUSTED ENCODER MOUNT OF LEFT X & Y AXES

11-A

25X

EXHIBIT "F"

Work Statement for Encoder Installation

The following is the work [redacted] will perform and materials that will be supplied to install encoders and counters on 552A -101. 25X

1. Purchase and fabricate brackets and electrical cables to install four (4) [redacted] Model 27-625 [redacted] Encoders on viewer scanning mechanism lead screws. 25X

2. Fabricate and purchase necessary components to install [redacted] Switch Assembly, part number 701486-1, with additional provision for an AC power receptacle rear panel for keeping power on [redacted] Synchronizer at all times. This Switch Assembly will include four (4) [redacted] Model 15EL-44 modules to interface encoders and counters. X1 X1 25X

3 Fabricate and install [redacted] Sloped Front Cabinet, part number 602090, to house [redacted] Model 2825B, Control Panel. 25X 25X

4. Fabricate and install arm and associated customer's cabinet reinforcements for above Sloped Front Cabinet.

5. Provide services to insure proper encoder signals to counters.

Customer will provide the following and will take responsibility for its debugging, mating and operation:

EXHIBIT "B"

Continued

X1 1. (4) [redacted] Model 2826C Reversible Counters

X1 2. (1) [redacted] Model 2827B Synchronizer and Card Punch Coupler

X1 3. (1) [redacted] Model 2825B Control Panel

4. All necessary cables to interconnect above units and

X1 to [redacted] Switch Assembly, except those from the encoders.

5. Suitable cabinet for above, properly equipped with forced ventilation, panels, casters and clearances for customer supplied equipment and cables.

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